

ALUMINUM

Project Fact Sheet

Non-VACUUM ELECTRON BEAM WELDING/PLASMA WINDOW



INNOVATIVE METHOD OF WELDING SIMILAR AND DISSIMILAR METALS ELIMINATES VACUUM PUMPING, REDUCING ENERGY USE, EMISSIONS, AND COST

Benefits

- Could save 116,000 kWh per unit annually
- Could save 539 billion Btu annually by 2010
- Allows welding components and assemblies of any size
- Lowers purchasing and installation costs by \$150,000 to \$200,000 per machine
- Eliminates the need for welding chamber vacuum pumps and their maintenance, saving \$10,000 per machine
- Improves welding efficiency by eliminating vacuum-pumping time, saving 25 to 30 minutes per hour per machine
- Reduces required floor space by 40% per machine

Applications

This technology will benefit industries and different manufacturing sectors worldwide that require welding, scribing, heat treating and other applications. It will also dramatically improve the efficiency of welding large products such as automobiles, ships, and airplanes, as well as intricate products such as medical components without sacrificing weld quality. The aluminum, steel and metal casting industries will realize significant benefits, as will those involved in materials science research and advanced materials manufacturing.

Project Partners

NICE³ Program
Washington, DC

Connecticut Department of
Environmental Protection
Hartford, CT

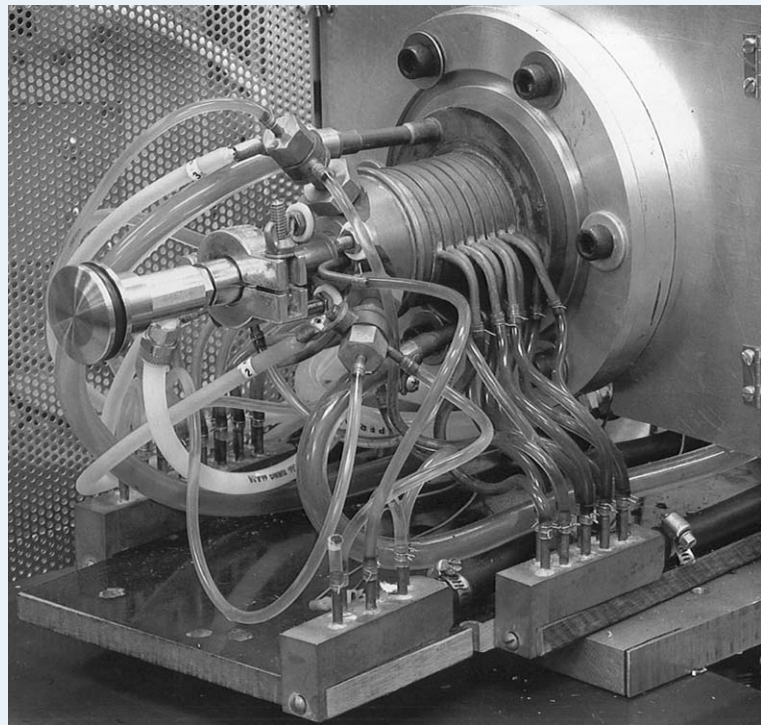
Acceleron, Inc.
East Granby, CT

Conservation Fund/
Connecticut Light & Power
Hartford, CT

Brookhaven National Laboratory
Upton, NY

Electron beam welding (EBW) produces high-quality welds, but due to the vacuum requirements, is usually more expensive than conventional welding. The pieces to be welded in the EBW process must fit within a vacuum chamber, thus limiting EBW's use in high-volume production. EBW restricts the quantity and size of parts that can be welded within a pump down cycle, and requires high tooling costs to hold and manipulate multiple parts. The large diffusion pumps and mechanical pumps used to maintain the vacuum are very costly, as are the special oils required for these pumps. The oils add to increased operating costs and environmental stresses. To address these limitations and associated costs, Acceleron Inc., is developing a plasma window that permits

PLASMA WINDOW ELECTRON BEAM WELDER



Acceleron's plasma-window technology will revolutionize the way similar and dissimilar metals are welded, saving as much as 90% of the energy used in today's conventional electron beam welding method.



an electron beam, formed in a vacuum, to operate effectively and efficiently in the open air. The "window" is a stabilized gas plasma transparent to the electron beam. The pieces to be welded can be of any size now that they are no longer required to fit within a vacuum chamber.

Project Description

Goal: Manufacture and demonstrate a floor-ready plasma window enhanced electron-beam welder and verify benefits over existing technology. The plasma window serves as a transparent barrier between high- and low-pressure regions. Its density is low enough to be transparent to the electron beam but dense enough to preserve the high vacuum necessary to generate the electron beam.

The window has a very strong lensing effect on charged particles, particularly electrons, allowing the beam to be focused to a very small spot. The plasma window has been shown to be 230 times more effective than conventional differential vacuum pumping.

Acceleron is developing the plasma window with assistance from the Connecticut Department of Environmental Protection, Brookhaven National Laboratory, a grant from the U.S. Department of Energy's NICE³ Program and grant assistance through the Conservation Fund which is administered by Connecticut Light & Power.

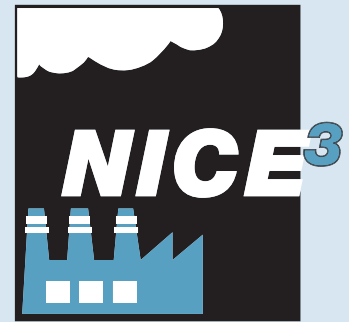
Progress and Milestones

- Complete design of intermediate mounting structure for the plasma window.
- Complete fabrication of arc and begin shielding design and manual testing.
- Complete shielding designs; demonstrate welding, drilling, and in-house weld evaluation; purchase viewing camera; and design and build automation.
- Complete and test software control and demonstrate using operator's automated control panel; begin production evaluation.
- Complete final process and production sample evaluation – metallurgy and testing.
- Submit the final report.

Economics and Commercial Potential

Acceleron's plasma window permits use of EBW in open air to weld large pieces, which were previously impractical. The innovation eliminates the need for large vacuum pumps, with a cost savings of \$150,000 to \$200,000 per welding unit and annual maintenance savings of \$10,000 per unit. Vacuum pump oil (\$1000/gallon) and the use of chlorine, biocides, and soda ash in pump process water are also eliminated. The floor space required is reduced by 40%. Overall, these improvements cut EBW operating costs in half. Eliminating large vacuum chambers cuts electricity use in pumping by 80% to 90%, which will allow EBW to be used on workpieces of unlimited size.

Annual savings of 539 billion Btu could result from 558 units if one unit operates 4400 hours a year, if first sales occur by 2003, and if 30% of the potential U.S. market of 3000 machines is replaced with the new window by 2010. Market penetration of 70% by 2020 could save 1.39 trillion Btu from 1549 units.



NICE³ – National Industrial Competitiveness through Energy, Environment, and Economics: An innovative, cost-sharing program to promote energy efficiency, clean production, and economic competitiveness in industry. This grant program provides funding to state and industry partnerships for projects that demonstrate advances in energy efficiency and clean production technologies. Awardees receive a one-time grant of up to \$525,000. Grants fund up to 50% of total project cost for up to 3 years.

For project information, contact:

Don Christensen

General Manager
Acceleron, Inc.
21 Lordship Road
East Granby, CT 06026
Phone: (860) 651-9333
DChristensen@acceleron-enbeam.com

Home Page:

www.acceleron-enbeam.com

For more information about the NICE³ Program, contact:

Lisa Barnett

Program Manager
NICE³ Program
Phone: (202) 586-2212
Fax: (202) 586-7114
lisa.barnett@ee.doe.gov

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www.oit.doe.gov

Office of Industrial Technologies
Energy Efficiency and
Renewable Energy
U.S. Department of Energy
1000 Independence Avenue SW
Washington, D.C. 20585-0121



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